ROYAL COLLEGE OF SURGEONS OF ENG
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AN ADDRESS ON LONGEVITY AND THE MEANS OF ATTAINING IT.

DELIVERED AT THE OPENING MEETING OF THE MANCHESTER MEDICAL SOCIETY, OCTOBER 3, 1906.

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MR. PRESIDENT AND GENTLEMEN,—Long life has at all times been regarded as one of the greatest blessings that a man can possess, and this feeling finds expression in the common acclamation "Let the King live" or "Long live the King." But long life is only to be desired when the faculties which render it a pleasure to its possessor or pleasing to his relatives and friends are retained in sufficient measure. Although the Prayer-Book contains a petition against sudden death, yet this is only to be regarded as a petition against unprepared-for death, for sudden death, though sad for those who are left behind, is really a great boon to the one who goes. But it does seem a very sad thing to see a man, whatever his age may be, cut down when his powers as yet show no signs of decay and when increasing age has brought with it increasing wisdom and power to direct and to help others. Less than six months ago I saw a gentleman who, despite his 76 years of age, was strong, erect, and to outward appearance healthy in body as well as vigorous in mind. He was a man of great influence in the commercial world, universally respected, his opinion deferred to, and, at the time I saw him, full of schemes as to what he was going to do. I found, however, that the tension in his vessels was so exceedingly high that I not only prescribed vascular dilators to lower the pressure within the vessels, but wrote to warn his medical man of the extremely precarious condition of his patient. In spite of the treatment, however, the fatal issue which I dreaded occurred in less than a week. This man's life had exceeded the span of three score years and ten, yet he had all the mental energy of a man in the prime of life combined with the long experience which enabled him to direct it to the best advantage. Although three score years and ten are generally regarded as the term of life, yet we see men who have exceeded it—such as the late Mr. Gladstone, the present Prime Minister, and the ex-Lord Chancellor—all doing work which would be severe for a man in the prime of life, and doing it well. The late Mr. Sidney Cooper painted up to the time of his death and almost rivalled in this respect Giovanni Bellini, who is said to have painted his best picture after the age of 90, and Titian, who painted up to the age of 99, when he died from plague. An even more striking example is that of the distinguished French chemist, Monsieur Chevreuil, who, I believe, lectured at the College of France up to the age of 100, and a year and a half ago I had the pleasure of being present as a guest of Dr. W. Milligan at the dinner given to Señor Garcia on his hundredth birthday, a day on which the old gentleman went through an amount of fatigue that might have killed many a younger man.

The object of my paper to-night is chiefly to consider the nature of the risks which old people run and how they may be best foreseen and averted so that great activity in advanced years such as appear in the examples I have just given may become the rule instead of the exception. These risks may apparently be divided into (*a*) those which arise from external influences; and (*b*) those which originate in the body itself. Of course, the action of both classes of causes may be, and often is, combined. Thus infection from without, such as pneumonia or erysipelas, might often be successfully withstood even in advancing years were it not for the presence of degeneration in the kidneys and atheromatous changes in the vessels, or enfeebled heart might continue for years were it not for a sudden fall or shock which cuts short the thread of life.

Through the kindness of the Registrar-General, Sir William Dunbar, and the able assistance of Mr. Finch, I have obtained some interesting tables showing the numbers living at various ages for 70 years back. It is by no means easy to read statistics aright, but, so far as I can see, these tables show a continuous increase in the expectation of life at birth, roughly speaking, from a little under 40 years in 1854 to a little under 48 years in 1900. In the decades from 60 to 90 years there is a slight diminution and this is also the case at the age of 100 for males. There is a little increase at this age for females. There is an increase in the number of survivors to the age of 80 both in men and women, but fewer men live to the age of 90, though more women do so than 60 years ago. The number of men living to 100 years per 100,000 of the population from 1891 to 1900 is only seven and of women 24, as compared with 15 men and 30 women in 1838 to 1854. These figures are, however, vitiated by the fact that between the ages of 55 and 65 there has always been a tendency to over-statement—a tendency that grows as age advances, so that very little reliance can be put on the data of extreme ages. During the last 50 years this tendency to over-statement has decreased slowly and irregularly in the age group 65 to 75, but rapidly and continuously at the higher age groups. The decrease has been so considerable that the numbers returned at the ages over 85 in 1901 were probably more nearly correct than those at ages over 75 in 1861 and 1871.

One of the first points that naturally attract inquiry in regard to influences from without is that of septic infection and the benefit which is likely to have been produced by the introduction of antiseptic methods. The statistics of surgical operations show very clearly the good effect of antisepsis, but a still wider basis is afforded by the statistics of death-rates from childbirth, including puerperal and septic diseases. These sank from 335 per 1,000,000 in 1861–70 to 295 in 1891–1900, and in all probability as antiseptic methods become more widely diffused over the whole country the proportion of deaths will sink much lower still. The more rigid application of antiseptic methods to diseases of the bladder and the introduction of prostatectomy are likely to increase longevity in males to a considerable extent, because even at present many men die much sooner than they otherwise would from septic infection of the bladder by non-sterile catheters. Despite antiseptics, erysipelas is still a very common cause of death among the aged, and this disease also ought to be disminished greatly by proper antiseptic measures. Respiratory diseases, bronchitis and pneumonia, carry off a great number of aged people. Both of these are usually ascribed to the effect of cold, but it should be borne in mind that while both are consequent upon exposure to cold, yet in both pathological organisms play a great part. Although Pasteur's experiment with fowls is so well known that it may seem useless to repeat it, yet it is of such fundamental importance that I venture to remind you that the French savant discovered that fowls, the natural temperature of whose body is nearly 104° F., are immune from anthrax, but if they are made to stand with their feet in cold water until their temperature is sufficiently lowered they then become susceptible to the disease. In the same way many apparently healthy people carry about in their pharynx the germs of pneumonia but do not take the disease until their vitality is lowered by exposure to chill. Two factors are required to give rise to the disease—the lowered vitality of the patient and the infection from without, and neither will produce the disease without the presence of the other.

To discuss fully the subject of infection from without would involve a consideration of infection generally. Time will not permit of this, but in regard to this subject it may be well to consider that many so-called common colds are very infectious and are readily transmitted from one person to another. One of the most violent attacks of bronchitis which I ever had originated very markedly in a local affection. I was travelling in the corner seat one day in a very dusty railway carriage. Some of the dust from the window appeared to get into the nostril nearest to it, causing me to sneeze. This sneezing fit developed into a one-sided cold in my head, the other nostril remaining quite free for more than a day. The catarrh then seemed to creep round the posterior nares and affect the other nostril. It then passed down into the trachea and finally into the bronchi. For many years I have been very firmly convinced that colds are very infectious and on one occasion I was going to call upon a friend of mine, a very old lady, who was confined to the house and attended by her children with the utmost care. I had already driven about a mile or more on my way when I began to think that I had a cold in my head and that I might possibly communicate it to her. I accordingly turned back and I think it was well that I did so, because about a couple of months afterwards I heard that she had remained perfectly well, living in two rooms, until some lady friends called, one of whom had a cold in the head. Immediately afterwards my friend began to suffer from bronchitis and had a most severe attack. It seems to me that very often children convey infection from one to another, and often a child goes to school, comes back with a cold, and then, as the common saying is, "the cold goes through the house." This possibility of infection by children is naturally to be borne in mind in regard to the relations of very old people to them as well as to friends and visitors. It is to be remembered also that people who are apparently perfectly well may carry about disease germs and convey them to others, and that those who have been in constant attendance upon a case of pneumonia, diphtheria, or possibly bronchitis, may convey the germs to others without being apparently affected themselves. It might cause a little trouble but it would be an error on the right side if all those who had been in or near such cases were compelled to disinfect their throats by gargling with an antiseptic before visiting or attending upon old people.

Another point which is worthy of consideration is the effect of dust in producing colds. I have already mentioned the effect of dust from a railway carriage in causing first inflammation in the nostril and then general bronchitis. I do not know whether any experiments have been made upon the specific gravity of microbes, but at the time when I used my consulting room as a library I found very frequently that if I had occasion to consult a book from one of the top shelves I was apt to get a cold in my head. This recurred with such regularity that at last I took to sponging the top of the book with a solution of carbolic acid before using it. Everyone knows what a great amount of dust can be seen in a room after anything has been moved about if the shutters are closed and a ray of sunshine streams through a chink. Some of the floating particles which are then seen in such abundance are probably pathogenic, and protection of aged people from infection by dust is therefore, I think, very important. I have already quoted Pasteur's experiments with fowls, and in guarding aged people from disease we have not only to prevent the access of microbes but also the incidence of depressing conditions. One of these, no doubt, is cold and one very frequently sees that after the occurrence of sudden and severe cold weather not only is the column of deaths in the *Times* much longer than usual but it contains an unusual proportion of old people. In order to prevent the effect of such cold the clothing should not only be warm and the rooms of a proper temperature but care should be taken that old people do not go out of warm rooms into cold parts of the house. In many houses, although the rooms are warm the passages are very cold, and the most dangerous place of all is probably the water-closet, because here the old patient, who would never dream of going outside the house without being thoroughly wrapped up in the warmest of clothing and protected by rugs, will not only go out with nothing on but a thin night-dress, but will remain sitting for many minutes although the closet is quite as cold as the air outside. I lay particular stress upon this point, not only because it is one that I have never seen mentioned but because it was particularly impressed upon me by the death of a patient and friend who had been perfectly well so long as he used a commode in his room, but one day he went to the water-closet and caught a chill, which was followed by a fatal attack of pneumonia.

A chill of the whole body reduces vitality and renders patients more liable to disease, but a local chill is particularly injurious. There is an old adage—

> "If wind blow at you through a hole
> Make your will and sain your soul."

Wind which comes fairly in one's face is little to be dreaded, but if wind catches one at the back of the neck, behind the ear, or even at the side of the head, it is much more dangerous.

Largely open windows are comparatively safe, but a chink through which the air blows with force is to be carefully avoided. One reason of this probably is that wind blowing through a chink causes a more rapid current of air, and thus chills the part of the body against which it impinges much more quickly than air moving slowly, and still more than air which is not moving at all. Everyone knows how in the Alpine health resorts the temperature may be many degrees below zero and yet cold is not felt so long as the air is still, but whenever the wind begins to blow the cold becomes almost unendurable. There is one kind of draught that many people seem to forget, and that is the draught between the door and the fireplace. If one's hand is placed at the lower edge of a door when a brisk fire is burning in the grate a considerable draught will be felt. This cold air spreads itself out over the floor of the room as it passes along, but again collects into a narrower stream close to the fireplace, so that the feet of anyone sitting by the fireside are apt to be swept constantly by the cold air, and thus the body is chilled. To avoid this the chair in which an aged person sits should be placed so far away from the fireplace as to avoid this draught, or else the feet should be kept raised by a somewhat high stool, so as to be above the level of the draught.

But while we take all due precautions to prevent injury from without, we must not forget that one of the most important methods of securing health is to increase the patient's power of resistance. Some years ago a governor-general of Canada asked an Indian, whose clothing was of the scantiest, although the weather was extremely cold, how it was that he was able to go about with so little clothing without apparently feeling chilled. The Indian said, " You do not cover your face, do you feel cold in the face ? " " No," said the governor-general. " Well, then,' said the Indian, " Indian all face." The scientific explanation of this power of resisting cold was given many years ago by Professor Rosenthal, who showed that the peripheral vessels when subjected to a high temperature for a length of time lose their power of contraction when again exposed to cold. In consequence of this the blood continues to pour through the chilled skin, and thus the temperature of the whole body is reduced. By training the vessels to alternate heat and cold, as we do in our faces, and as the Indian did in his whole body, they react more quickly to changes of temperature, and thus become more efficient regulators of the animal heat. This may be done to a certain extent by daily baths, care being taken, however, that the application of cold is not sufficiently great or sufficiently prolonged to depress the patient, and I think one of the best ways is to apply hot water as hot as it can well be borne, and then a little cold afterwards, just enough to get the reaction. But it is not only the vessels of the skin which require exercise and training. The resistant power of the patient depends very greatly upon the power of his general circulation and the perfection of his respiratory movements. This has been very well pointed out in an admirable lecture "On the Prolongation of Life," delivered by Sir Hermann Weber before the Royal College of Physicians of London three years ago. He himself presents such a splendid example of bodily and mental vigour at the age of 83 that the plan he follows must, I think, be good, and I reproduce here the description which he gives of his method :—

> I have mostly commenced with moderately deep inspirations and expirations continued during three to five minutes, once or twice a day, and have gradually increased the exercises to ten minutes or a quarter of an hour. The depth of each inspiration and expiration, and the duration of holding the breath are likewise to be only gradually increased. At the beginning, a sixth or a quarter of a minute for every inspiration and every expiration ought to be sufficient ; if this is well borne, each act may be gradually prolonged in duration, so that in the majority of cases each inspiration and each expiration may be brought up to a minute : all the movements are to be made slowly, not rapidly. I usually advise to inspire in the erect position with raised arms and closed mouth, and to bend down the body during expiration so that the fingers touch the ground or the toes. By degrees one can learn to make several up and down movements during every inspiration, and bend and raise the body several times during the expiration. By this alternate bending and raising of the body we gain the additional advantage of strengthening the lumbar muscles, and through this successfully combating the tendency to lumbago. Another useful combination with the respiratory exercises is the turning of the body round the axis of the spinal column alternately, with deep inspiration from left to right and with expiration from right to left with half-raised arms. By this movement we bring

into action some of the muscles of the spine which are apt to be only imperfectly used by most persons in advanced years, and the stiffness of the neck and spine, and the tendency to stoop so common in old persons, can be to some degree corrected by this kind of movement, if commenced in good time and practised regularly and thoroughly. The swinging of the arms round the shoulder-joint is likewise a useful combination. Other combinations with muscle and joint movements will occur to those who have accustomed themselves to these respiratory movements ; but the latter ought always to have our principal attention, since to them the beneficial effect on the heart and lungs is mainly due. In addition to the influence on the circulation, the respiratory movements keep up the nutrition and efficiency of the lungs themselves, which undergo in old age a kind of atrophy ; the walls of the smallest divisions and air cells become thinner and a kind of senile emphysema is developed, which by these exercises is to some degree prevented. Another important influence consists in maintaining the elasticity of the chest walls, which are apt to become stiff in old age, and thus to interfere with free movements of the lungs and the pleura. If for some reason the erect position should be inconvenient the mere respiratory movements can be made also in the horizontal and sitting positions.

In addition to the regular exercises to be taken every morning, he strongly advises a daily walk for from half an hour to three hours, part to be taken in the morning and part to be taken later in the day, and once a week he recommends a day of more prolonged exercise up to four or six hours, and once or twice a year a walking or climbing tour of three or four weeks. For those who are unable, either from want of natural strength or from want of opportunity, to take the walks recommended by Sir Hermann Weber, the exercises which he mentions are strongly to be recommended, and for the patient who is too weak to take even these, massage may be employed, or to a certain extent substituted.

With advancing years certain organs acquire naturally a greater power of resistance to bacterial invasion, and this is markedly the case with the intestinal canal. In childhood intestinal diseases of *bacterial* origin are the most common and fatal of all, but in old age they are comparatively rare. This statement is, I think, correct in the form in which I have put it, but it might be hazardous to make the broader statement that *microbic* disease of the intestinal canal is rare in the old, for amongst the most common and important causes of death at an advanced age cancer takes a very high place. Whilst in the decade 1891 to 1900 pneumonia is responsible for an annual death-rate of 8089 per 1,000,000, cancer in the same period caused a mortality of 12,201. With the exception of the breast and uterus in females, by far the commonest seat of cancer is the stomach, and next to it come the liver and gall-bladder up to the age of 85 years. After this stage the uterus still remains the commonest seat in women and the skin becomes commoner in men, but with this exception the stomach and liver remain the commonest seats of cancer. In the present state of our knowledge it is impossible to decide whether the peculiar kind of growth which characterises cancer cells and resembles that of reproductive cells is initiated by some microbes of a plasmodic nature, and belonging rather to the animal than to the vegetable kingdom, or whether it is simply due to irritation, mechanical or chemical. Such stimulation of a chemical nature has been observed by Loeb to produce fertilisation in the eggs of sea urchins. These eggs are usually fertilised by spermatozoids, but if they are simply immersed in stronger brine than that to which they have been accustomed, they become fertilised by the stimulation which this supplies. Whether such stimulation produces similar changes in the tissues of higher animals we cannot at present say, but, at any rate, we know that the irritation produced in the lip by a pipe or in the gall-bladder by stones is very apt to be followed by cancer. Consequently, in order to avoid cancer, we ought to try to lessen irritation by all means wherever that may be present, and more especially we ought to prevent it from affecting the pylorus or liver. Now, one of the commonest causes of irritation of the pylorus, both mechanical and chemical, is unchewed food, which, because of its size, cannot be penetrated by the digestive juices of the stomach and dissolved. When it tries to pass as a solid lump through the pylorus, it either acts as a mechanical irritant during its passage, or produces chemical irritation by causing reflex contraction of the orifice and retention of food in the stomach. This retention causes increased acidity, which frequently reaches such an extent as to produce heartburn or vomiting. A little more time spent on the mastication of food might, therefore, be well expended, not only as producing present comfort, but lessening the probability of organic disease. The practice of gobbling may, to a certain extent at least, be responsible for the larger proportion of cancer of the stomach which occurs in men than in women at the age of 55 years, the numbers being 3244 and 2867, while at 65 years the numbers are nearly equal, being 2985 and 2917, and at higher ages they are reversed.

In reference to bacterial invasion no one can speak with more authority than Metchnikoff, and he says that in the alimentary canal no less than 128 billion bacteria are formed daily. Some of these may be useful in assisting digestion, but others are pathogenic and may give rise to toxins dangerous to health or fatal to life. In order to prevent the introduction of "wild bacteria," he advises that no unsterilised food should be taken, and he avoids uncooked salad and fruit. Especially to be avoided are strawberries, which are very frequently contaminated by lying on manure which has been spread on the beds, and cherries or plums which have been attacked by birds, because he has seen birds go straight from a manure heap to a cherry tree, and thus convey microbes from the former to the latter. Another way of killing such "wild microbes" as may find access to the intestinal canal in spite of all precautions, is to cultivate "tame microbes," which will attack and destroy the wild ones without doing any harm to the organism. Amongst the most beneficial of these "tame microbes" is the lactic acid bacillus and the consumption of sour milk containing it is to be regarded as an important means of disinfecting the intestinal canal, of stopping intestinal disturbance, of preventing the formation of toxins, and thus increasing health and prolonging life. These observations and views of Metchnikoff require the careful consideration of all those who are interested in the supply of pure milk, either in town or country: for if they are correct, as I believe them to be, the addition of such preservatives to milk as shall prevent it from turning sour and yet allow other bacteria than the lactic acid bacillus to develop in it is a proceeding likely to inflict the gravest injury on the public health. It is curious that this new scientific development should so closely agree with the practice which used to prevail in country districts in Scotland, where sour milk and porridge formed the staple food of children as set forth in the old ballad, where a schoolmaster says:—

"Gie a bairn his parritch,
And dinna spare the soor douk can,
An' wi' a penny carritch
I'll mak' your son a man."

In women, cancer of the liver is much more frequent than in men, being in the proportion of 3 to 2 in all the decades above 55 years. The cause of this is probably to be found in their usually sedentary habits, along with their practice of drinking small quantities of water, which tend to produce thickened bile and gall-stones and thus cause greater irritation of the biliary passages.

The question has been raised whether tissues which receive a superabundance of nutriment are more apt to take on cancerous growth than those which are less superiorly nourished. There seems little doubt that cancer is more common among the well-to-do or rich classes than amongst the poor, but it is impossible to say in the present state of our knowledge how far abundant nutrition increases the growth of cancer.

We know more, however, about the effect of diet upon a class of diseases which is much more important and much more fatal amongst the aged than even cancer: I mean diseases of the circulation. In the decade 1891 to 1900, for 12,201 deaths which occurred from cancer above the age of 75 years, no less than 34,822 died from heart disease and 39,662 from diseases of the blood-vessels above that age. Nor does this even cover all the mischief done by diseases of the blood-vessels, for apoplexy, paralysis, and senile decay may all be reckoned as secondary to disease of the cerebral vessels. In his most instructive book "On the Nature of Man," Metchnikoff mentions that there are two classes of phagocytes in the body, the small or microphags and the large or macrophags. The function of the microphags is to rid us of microbes, that of the macrophags is to heal mechanical injuries, such as hæmorrhages, wounds, and so forth. In the brains of old persons and animals a number of nerve cells are surrounded and devoured by macrophags (Fig. 1), and Metchnikoff thinks himself justified in asserting that senile decay is mainly due to the destruction of the higher elements of the organism by macrophags. Other parts of the body also are not safe from their attacks and the kidneys may likewise suffer (Fig. 2). But the function of the macrophags is not to attack healthy tissues, it is to remove those the vitality of which is destroyed or impaired, and so long as the brain cells are abundantly supplied with blood they will probably be allowed to remain uninjured by the attacks of the macrophags. I think, therefore, that while senile decay may be actually produced by the macrophags, we are justified in believing that it really originates in an alteration of the blood-vessels.

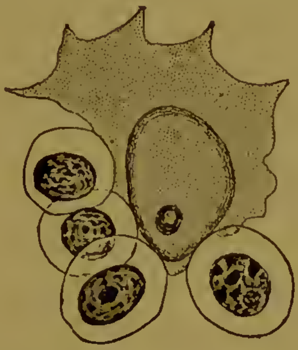

FIG. 1.—Cell from the brain of a woman, aged 100 years, being devoured by macrophags. (From Metchnikoff.)

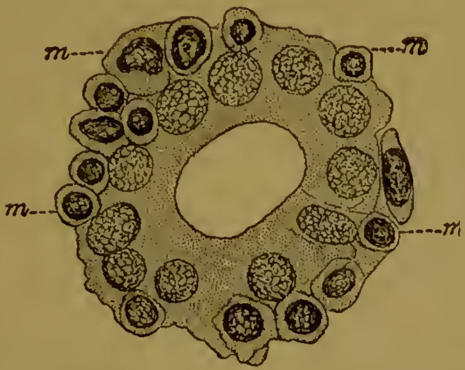

FIG. 2.—Section of a renal tubule invaded by macrophags, from the body of an old man, aged 90 years (m = macrophags). (From Metchnikoff.)

Nor is it only in nervous disease that there is alteration in the vessels, for cardiac weakness, which is such an important cause of death in old age, may be traced back also to alteration in the vessels. It is the narrowing of the coronary vessels and consequent imperfect supply of blood to the heart that leads to fatty degeneration of that organ, while, on the other hand, arterio-sclerosis increases the peripheral resistance which the heart has to overcome in keeping up the circulation and thus increases the tendency to cardiac failure on the one hand as well as to apoplexy on the other. Arterio-sclerosis is generally divided into two forms: (1) the nodular or atheroma; and (2) the diffuse form which affects the smaller arteries and corresponds to the arterio-capillary fibrosis of Gull and Sutton. Arterio-sclerosis may therefore be looked upon, *par excellence*, as the great enemy to longevity, and if it can be prevented or its effects neutralised, life will almost certainly be greatly prolonged. It has been long noted that arterio-sclerosis is commonly associated with hypertrophy of the heart and atrophy of the kidneys, and it has been frequently suspected that non-elimination of waste products might be one of the chief causes, if not the only cause. In 1888 Gilbert and Lion found that aortitis could be produced by the intravascular injection of bacterial toxins, especially in a vessel which had been injured mechanically, and their results were confirmed by subsequent observers. In 1903 Josué found that atheroma of the aorta with hypertrophy of the heart could be produced by the prolonged intravascular administration of adrenalin. Erb, junr., obtained a similar result and considered that it might be due partly to a toxic action of the drug on the non-striated muscular fibres and partly to the high tension produced by the adrenalin. Other experimenters tried the effect of various drugs which raise blood pressure and got similar results—Boveri from tobacco, Fisher from digitalin, Orlovski from strophanthin and adonidin, and, what is very interesting, Croftan obtained it from the use of hypoxanthin, which, as you all know, is one of the constituents of muscle extract. The whole subject has been taken up by Dr. G. R. Rickett, who has kindly lent me his thesis on the subject, from which I have extracted the experiments just quoted. In his own experiments Dr. Rickett not only obtained atheroma by the use of adrenalin and of tobacco, or nicotine, but also of squill and barium chloride. All of these poisons tend to cause continuous high tension in the vessels, and this is the only power which they seem to possess in common.

The process of arterio-sclerosis appears to commence in the breaking up of elastic fibres. In atheroma the fractures are multiple and aggregated, and in arterio-capillary fibrosis they are single and separate. An irritant which would tend to cause inflammation within the vessels but not produce a rise of blood pressure, such as potassium cantharidate, did not produce atheroma and no change was observed in the vaso-vasorum, and it seems unlikely that such extensive changes are due to stretching, more especially when we consider that the lumen of peripheral vessels, both in disease and during the action of the vaso-constricting drugs already mentioned, is diminished below the normal. It seems to me therefore that we must look for some other cause, and the most likely one I think is diminished movement in the vascular wall due to high tension and the loss of self massage which occurs in the vessels and maintains in their walls a constant interchange of lymph, for arteries are surrounded by a fibrous sheath inclosing the lymph space in which there is the fluid from which the vascular wall derives its nutriment. Each time that the artery is dilated by the blood forced into it during the cardiac systole the lymph is driven out of the sheath, while at the contraction of the artery during the cardiac diastole, more fluid tends to flow in from the vaso-vasorum (Fig. 3). It is evident that if the difference between the size of the artery at each pulse and at each interval is great, there will be a correspondingly free circulation of lymph in the sheath of the vessel, but if the difference be very small the movement of the lymph will be slow and imperfect. Now with the higher blood pressure the oscillation of the vessel is greatly diminished, as is shown by the copy of the tracing from Marey which I now show you (Fig. 4), and in which the pulse is seen to be full and soft in the ordinary condition; but the oscillation is very small when the pressure is raised by compression of the femoral arteries. Whether the explanation I have given be right or not, it appears to be a fact that continued high tension within the arteries leads to arterio-sclerosis, to degeneration of the vessels themselves, and to liability to rupture. It thus tends to produce apoplexy on the one hand, and leads to cardiac hypertrophy, followed by cardiac degeneration and failure on the other.

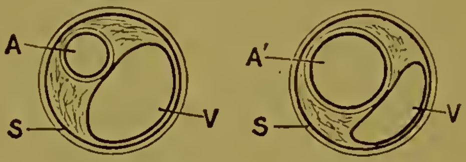

FIG. 3.—Diagram of the effect of the arterial pulse in aiding the circulation in the veins and self-massage of the artery itself. A is the artery, V the vein, and S the fibrous sheath which incloses them both and also a lymph space which is shaded in the diagram. A shows the artery contracted during the cardiac diastole with the vein distended with blood and the space with lymph. A′ is the artery distended with blood by the cardiac systole which at the same time drives the venous blood along and empties the lymphatic space.

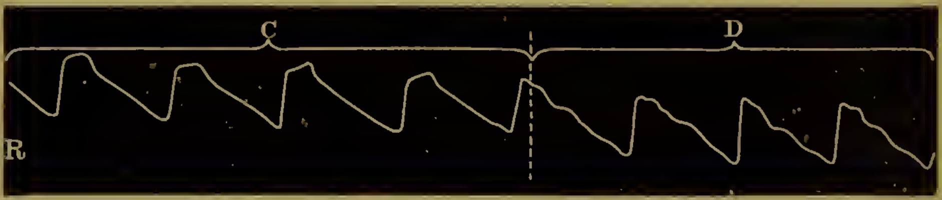

FIG. 4.—Sphygmogram from the radial pulse. The first half was obtained during compression of both femoral arteries, the second half after removal of the pressure. (After Marey.)

The question then arises, To what is continuous high pressure due? I have already mentioned that hypoxanthin, one of the products of muscular waste and one of the constituents of extract of meat, will produce continuous high tension and atheroma when injected into the vessels. The close association of atrophy of the kidneys with high tension and arterio-sclerosis naturally suggests the thought that the high tension may be due to the retention of waste products in the blood and their continued action upon the vessels. It is quite possible that this is so, and in order to prevent it the natural method of treatment is to lessen the quantity of such substances by reducing the amount of butcher's meat in the diet and increasing elimination by the ingestion of water. But recent researches have shown us that the tissue change in the body is a much more complex thing than was at one time imagined and that the kidneys may not only have the function of excreting urine that is passed out, but of secreting substances which go back into the blood. Some very curious experiments were made by Professor Schmiedeberg a good many years ago. He found that when blood containing benzoic acid was circulated through the vessels of an excised kidney, hippuric acid and not benzoic acid was excreted through the ureter. But, on the other hand, if hippuric acid was passed with the blood through the vessels of the kidneys benzoic acid was excreted through the ureter. The kidneys have thus a reversing action, but if they have undergone atrophy such an action will be gradually diminished or abolished. A circumstance which renders this action more worthy of attention is that Oliver has found that hippurates have the power of lowering blood pressure. The secretion of thyroid gland tends to dilate the peripheral vessels and thus to lower the blood pressure, so that in atrophy the pressure tends to rise, and this has been found in atheroma and myxœdema, though how far they are merely coincident, or how far the one is dependent on the other, we cannot yet say. An abundant meat diet, as Chalmers Watson has shown, stimulates the thyroid to increased growth, but later leads to atrophy, so that a large proportion of animal food in early life is likely to produce early atrophy of the thyroid with rise of pressure and all its attendant mischief. Lorand goes so far as to say that senile changes are simply a form of myxœdema and are due to atrophy of the thyroid, but excessive action of the other glands may possibly lead to a similar condition, and extensive atheroma at the early age of 59 was found by Parkes Weber in association with adenoma of the suprarenal capsules.

It is clear that early recognition of excessive tension is one of the most important steps towards increasing longevity, and for this purpose it is necessary to have some means of estimating the blood pressure. In the life of a busy practitioner it is impossible to do this unless it can be done quickly and easily as well as accurately. Many instruments have been introduced for the purpose; the earliest to be much used was one made by my old friend, the late Professor von Basch. The form he first used was a mercurial manometer, but this was so awkward in practice that he discarded it and adopted an indiarubber bulb which could be placed above the artery so as to obliterate it, and the obliterating pressure recorded by an aneroid barometer. Various modifications of this have been used, the most important being that suggested by Riva Rocci and also by Hill and Barnard. This consists in connecting a bag which surrounds the arm with a manometer. Two sphygmomanometers in which fluid is used to register the pressure are Hill and Barnard's small instrument and Oliver's new one. Both of these have the advantage of having a tolerably large scale and indicating the oscillations of pressure more readily than the aneroid. In this way the diastolic pressure can be fairly well ascertained as well as the systolic, and thus not only the maximum pressure obtained but the variations in it through the cardiac cycle, variations of which I have already described the importance. The systolic pressure is taken to be that which suffices to stop the pulse altogether, the diastolic to be that at which the index gives the maximum oscillation. In a recent article Dr. Janeway regards the normal systolic pressure with an armlet 12 centimetres broad as 145 millimetres and that anything under 160 is not to be considered pathological without further evidence. My own observations do not coincide with this, as I find that from 100 to 115 or 120 is normal for young adults, from 115 to 135 or 140 for men in middle life, and that above 150 it indicates an abnormal pressure. I am bound to say that I have seen men whose pressure was 180 and they were apparently in perfect health, but I consider these men in a precarious condition and liable to cerebral hæmorrhage on the one hand or cardiac failure on the other.

As a raised blood pressure is itself productive of degenerative changes in the vessels, we have good grounds for believing that if the rise be detected early and counteracted by proper regimen and treatment the vascular changes which it would otherwise produce might be prevented and life very considerably prolonged. The earlier this is done the better, and I think it is only likely to be done by the sphygmomanometer being used as frequently by the physician as the stethoscope or thermometer is at present, and with an instrument like Potain's modification of von Basch's the pressure can be taken as quickly and as easily as the pulse rate can be ascertained by the finger. When the tension is found to be above the normal for the age, attention should be directed at once to the diet. Butcher's meat and strong soups or sauces containing meat extract should be prohibited, or only allowed in very limited quantity. Where the tension is very high it may be necessary to limit the diet very rigidly indeed and only allow farinaceous foods with a small proportion of proteids. I once remember being called to see a case of cardiac asthma. The patient had an income of about £30,000 a year and had a medical man whose sole duty it was to look after him. The first question I asked was whether the urine was free from albumin. I was told that it was, but on getting it I found it to be almost like water, to have a very low specific gravity, and on acidulating it with acetic acid and boiling the top I found a faint haze which is so significant of gouty kidney, but which can sometimes only be seen by boiling the top of the test tube so as to have the lower part for comparison and viewing the top against a dark background. I at once advised that the patient's diet should be cut down to simple farinaceous food and milk, and upon this diet he soon became quite free from his attacks. I then went for a trip on the Continent and while I was away I heard of the old man's death. I suppose that someone else had been called in who regarded it as a burning shame that such a rich old man should be put upon a pauper's diet and yet this was all he could stand and a more liberal allowance of food would suffice to kill him. I think everyone must have been struck with the number of old people who die in workhouses. I regret to say that I have been unable to get any account of the numbers above 90 years of age, but in 1901 the proportion of workhouse paupers to 1,000,000 of the total number living at the same age of 85 or upwards was 95,631, that is to say, very nearly 1 in 10. A workhouse diet may not be very pleasing to the palate, but it certainly seems an efficient means of prolonging life and it might certainly be worth while sometimes for others to adopt it whose circumstances would allow of them to indulge in luxury.

Amongst other things which tend to lower the pressure are certainly the use of cholagogues and purgatives: mercurial, such as blue pill or calomel at night once or twice a week, followed by a saline in the morning, as often as may seem necessary. Iodide of potassium does appear to lessen the tension in many cases, especially when given in large doses, such as from 10 to 30 grains three times a day. The most efficient drugs for lowering blood pressure are the nitrites or nitrates, a class of bodies the physiological action of which was so well investigated by the late Professor Leech, whose death in the prime of life was not only a great loss to scientific medicine but a personal sorrow to everyone who knew him. Nitrite of amyl and nitrite of iso-butyl have a more rapid action than any other of the series and are useful in cutting short a paroxysm of pain. Nitroglycerine not only has a similar use but it can be given in divided doses during the day to keep the tension low. Nitro-erythrol has, I think, a still slower and more prolonged action, and ½ grain or more three or four times a day often suffices to keep the tension within moderate limits and completely to prevent attacks of angina, which previously had occurred many times a day. Latterly I have very frequently given nitrate of potash with nitrite of soda to reduce the blood pressure. A dose of 20 grains of nitrate of potash with ½ grain to 2 grains or more of nitrite of soda in a large tumbler of water every morning appears to have a double action in reducing tension, firstly by acting directly on the vessels, and secondly by clearing out products of tissue waste by virtue of its diuretic action. I described at the meeting of the British Medical Association in Manchester in 1902 the way in which I was led to use this combination, and I was very much interested to find quite recently that the very remedy which I was employing in consequence of pharmacological researches upon its action had been used empirically for the same purpose nearly 300 years ago by Lord Bacon, who placed his reliance chiefly on blood letting and the use of saltpetre as the best means of attaining long life.

I have to thank you, Dr. Buckley and Gentlemen, for the honour you have done me in asking me to give you this address, and I must also express my hearty thanks to the Registrar-General, to Dr. J. F. W. Tatham, and to Mr. Finch of the General Register Office for the valuable papers with which they have furnished me.

APPENDIX.

TABLES SUPPLIED BY THE KIND PERMISSION OF THE REGISTRAR-GENERAL.

1. What is the Average Length of Life in each Decade from about 1850 ?

The most reliable information on this point is that contained in the life tables which have been calculated from time to time. Life tables, based on the average mortality which prevailed among the general population of England and Wales, have been constructed for the periods 1838–54, 1871–80, 1881–90, and 1891–1900. These calculations show the following expectations of life :—

	Males.				Females.			
	1838–54.	1871–80.	1881–90.	1891–1900.	1838–54.	1871–80.	1881–90.	1891–1900.
	years.	years.	years.	years.	years.	years.	years.	years.
Expectation of life at birth	39·91	41·35	43·66	44·13	41·85	44·62	47·18	47·77
Expectation of life of those who reach the age of—								
60 years ...	13·53	13·14	12·88	12·93	14·34	14·24	14·10	14·10
70 ,, ...	8·45	8·27	8·04	8·05	9·02	8·95	8·77	8·78
80 ,, ...	4·93	4·79	4·52	4·62	5·26	5·20	5·00	5·05
90 ,, ...	2·84	2·66	2·37	2·58	3·01	2·90	2·75	2·87
100 ,, ...	1·68	1·61	1·24	1·51	1·76	1·62	1·54	1·81

The numbers surviving to ages 60, 70, 80, 90, and 100 (out of 100,000 born) are as follows :—

	Males.				Females.			
	1838–54.	1871–80.	1881–90.	1891–1900.	1838–54.	1871–80.	1881–90.	1891–1900.
Number born ...	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
Survivors to age—								
60 years... ...	35,633	36,501	39,840	40,952	38,397	42,284	45,768	47,304
70 ,, ...	22,349	22,206	23,863	24,663	25,316	27,723	29,922	30,917
80 ,, ...	8,034	7,735	8,002	8,230	10,039	10,894	11,454	11,807
90 ,, ...	932	802	679	772	1,380	1,423	1,342	1,433
100 ,, ...	15	8	3	7	30	23	16	24

Reference.—Supplement to the 65th Annual Report of the Registrar-General, Part I, pp. lxii, lxiii.

NOTE.—The greater expectation of life at the advanced ages in the earlier periods is undoubtedly due in large measure to mis-statement of age. The following extract from the Census Report bears on this point:—

"At every one of the censuses* under consideration the number of persons of each sex returned as over 55 years of age was approximately accurate. At some age between 55 and 65 years, however, there has always been a tendency to overstate the age—a tendency that grows as age advances, insomuch that very little reliance can be placed on the returns for extreme ages. During the last 50 years, this tendency to overstatement has decreased slowly and irregularly at the age-group 65–75, but rapidly and continuously at the higher age-groups 75–85, and 85 and upwards. The decrease has been so considerable that the numbers returned at ages over 85 in 1901 were probably more nearly correct than those at ages over 75 in 1861 and 1871."

Reference.—Census of England and Wales, 1901, General Report, p. 54 (last paragraph).

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* The censuses of 1861, 1871, 1881, 1891 and 1901.

2. WHAT NUMBER OF PERSONS IN EACH DECADE HAVE REACHED THE AGES 60, 70, 80, 90, 100, 110 (?) RESPECTIVELY ?

(Owing to the risk of error from mis-statement of age in multiples of 10 years, the numbers are given for the ages 55, 65, 75, etc.)

The numbers enumerated at the censuses of 1851, 1861, 1871, 1881, 1891, and 1901 were as follows:—

Males.

	1851.	1861.	1871.	1881.	1891.	1901.
All ages...	8,781,225	9,776,259	11,058,934	12,639,902	14,060,401	15,728,613
Total over 55 years ...	858,447	987,542	1,131,002	1,258,115	1,376,712	1,569,017
55–65 ,, ...	482,132	564,536	640,582	722,553	770,124	907,945
65–75 ,, ...	266,370	303,966	355,257	389,882	444,896	477,868
75–85 ,, ...	96,706	106,036	120,664	131,018	145,471	165,233
85–95 ,, ...	12,705	12,550	14,068	14,259	15,825	17,602
95 years and upwards	534	454	431	403	396	369

Females.

	1851.	1861.	1871.	1881.	1891.	1901.
All ages...	9,146,384	10,289,965	11,653,332	13,334,537	14,942,124	16,799,230
Total over 55 years ...	979,974	1,114,509	1,284,594	1,464,615	1,652,893	1,891,986
55–65 ,, ...	525,465	605,708	700,271	811,533	886,879	1,035,305
65–75 ,, ...	311,311	353,951	409,954	462,542	544,966	598,138
75–85 ,, ...	123,236	134,263	151,161	167,054	193,543	228,015
85–95 ,, ...	18,951	19,602	22,234	22,518	26,547	29,561
95 years and upwards	1,011	985	974	968	958	967

Reference.—Census 1901, General Report, p. 206, except the numbers for ages 85–95 and 95 and upwards, which are not given separately there ; they are from the reports on the censuses of the respective years.

Census 1851, Vol. I, p. cxciii.
Census 1861, Vol. II, p. xi.
Census 1871, Vol. III, p. xiii.
Census 1881, Vol. III, p. v.
Census 1891, Vol. III, p. v.
Census 1901, Summary Tables, p. 141.

All the figures may be obtained from these separate Reports, but they are shown for quinquennial age-groups.

The numbers living at each age to one million of the same sex living at all ages are as follows:—

Males.

	1851.	1861.	1871.	1881.	1891.	1901.
Total over 55 years ...	97,760	101,014	102,270	99,534	97,915	99,755
55–65 ,, ...	54,905	57,746	57,924	57,164	54,773	57,726
65–75 ,, ...	30,334	31,092	32,124	30,845	31,642	30,382
75–85 ,, ...	11,013	10,846	10,911	10,365	10,346	10,505
85–95 ,, ...	1,447	1,284	1,272	1,128	1,126	1,119
95 years and upwards	61	46	39	32	28	23

Females.

	1851.	1861.	1871.	1881.	1891.	1901.
Total over 55 years ...	107,144	108,311	110,234	109,837	110,620	112,624
55–65 ,, ...	57,451	58,864	60,092	60,859	59,354	61,628
65–75 ,, ...	34,036	34,398	35,179	34,688	36,472	35,605
75–85 ,, ...	13,474	13,048	12,971	12,528	12,953	13,573
85–95 ,, ...	2,072	1,905	1,908	1,689	1,777	1,760
95 years and upwards	111	96	84	73	64	58

Reference.—These proportions have not been published; they have been calculated from the numbers in the two previous tables.

NOTE.—The quotation as to overstatement of ages, given in reference to Query No. 1, applies equally to the above figures.

3. What Number of those who reached over 90 have lived in a Workhouse?

The numbers over 90 cannot be given; the numbers at ages 65–75, 75–85, and 85 and upwards are as follows:—

Males.

	1851.	1861.	1871.	1881.	1891.	1901.
65–75 years	9,137	10,769	15,169	—	21,995	27,789
75–85 ,, ...	4,699	5,881	7,639	—	11,177	14,921
85 years and upwards...	658	743	1,007	—	1,482	2,022

Females.

	1851.	1861.	1871.	1881.	1891.	1901.
65–75 years	6,066	6,934	8,496	—	14,336	16,814
75–85 ,, ...	3,781	4,274	5,041	—	8,754	12,139
85 years and upwards...	749	842	1,136	—	1,880	2,404

The proportions to one million of the total number of the same sex living at the same age are as follows:—

Males.

	1851.	1861.	1871.	1881.	1891.	1901.
65–75 years	34,302	35,428	42,699	—	49,439	58,152
75–85 ,, ...	48,591	55,462	63,308	—	76,833	90,303
85 years and upwards...	49,702	57,136	69,453	—	91,363	112,515

Females.

	1851.	1861.	1871.	1881.	1891.	1901.
65–75 years	19,485	19,590	20,724	—	26,306	28,111
75–85 ,, ...	30,681	31,833	33,349	—	45,230	53,238
85 years and upwards...	37,521	40,900	48,949	—	68,351	78,747

References.—For the numbers living in workhouses—

Census 1851, Vol. I, Summary Tables, p. cccxi.
Census 1861, Vol. II, Summary Tables, p. xcvi.
Census 1871, Vol. III, Summary Tables, p. lxxxi.
Census 1891, Vol. III, Summary Tables, p. lxiii.
Census 1901, Summary Tables, p. 184.

For the proportions—

Census 1891, Vol. IV, General Report, p. 78.
Census 1901, General Report, p. 161.

The others have been calculated from the numbers in the first table and the populations in the Table of Query No. 2.

The numbers of workhouse inmates in 1881 are not given in the Census Report: they were probably not abstracted.

The increase in the number of indoor paupers has been accompanied by a large change in the proportion of indoor and outdoor paupers.

In 1851 the proportion was about 7 outdoor to 1 indoor pauper; in 1901 the proportion was about 2½ to 1 (inferred from figures given in the Annual Reports of the Local Government Board; see 10th Report, p. 354, and 33rd Report, p. 438, which give the mean numbers of indoor and outdoor paupers for a series of more than 50 years). During the half-century 1851–1901 the number of indoor paupers nearly doubled; the number of outdoor paupers fell by about one-third.

Mean Annual Death-rates per 1,000,000 Persons Living at Ages 55–65, 65–75 and 75 and upwards in 1871–80, 1881–90 and 1891–1900.

Pneumonia.

	Males.			Females.		
	55—	65—	75 and upwards.	55—	65—	75 and upwards.
1871–80 ...	1,802	2,446	2,787	926	1,628	2,103
1881–90 ...	2,354	3,240	3,704	1,246	2,086	2,823
1891–1900...	2,583	3,550	4,481	1,403	2,445	3,608

Cancer.

	Males.			Females.		
	55—	65—	75 and upwards.	55—	65—	75 and upwards.
1871–80 ...	1,593	2,605	2,989	2,765	3,524	3,520
1881–90 ...	2,302	3,758	3,926	3,375	4,531	4,601
1891–1900...	3,160	5,325	5,824	4,099	5,829	6,377

Heart Disease.

	Males.			Females.		
	55—	65—	75 and upwards.	55—	65—	75 and upwards.
1871–80 ...	4,802	9,549	12,630	4,582	9,163	11,415
1881–90 ...	5,516	11,758	17,619	5,313	11,216	16,123
1891–1900...	6,008	12,623	18,366	5,573	11,631	16,456

Blood-vessels, etc.

	Males.			Females.		
	55—	65—	75 and upwards.	55—	65—	75 and upwards.
1871–80 ...	4,544	11,367	22,599	3,914	9,569	18,953
1881–90 ...	4,330	11,506	22,883	3,995	9,956	19,657
1891–1900...	3,895	10,208	20,840	3,650	9,080	18,222

NOTE.—The death-rates from pneumonia and from cancer are published in the Supplement to the Registrar-General's 65th Annual Report.

The death-rates from heart diseases and from diseases of the blood-vessels have been specially calculated for this table, and have been made comparable for the three periods as nearly as possible. It should be mentioned that the List of Diseases used in the Classification of Deaths was revised in 1881. A list of the changes affecting classification is printed on pp. lxxiv–lxxix of the Registrar-General's 57th Annual Report.

None of these changes affected the number of deaths referred to pneumonia.

Fibroid tumour was included with cancer up to and including the year 1880, but not subsequently.

Up to 1880, congestion of the brain was included with apoplexy, and general paralysis* and paraplegia with paralysis; consequently the mortality from diseases of the blood-vessels in 1871–80 is to some extent overstated; also hæmorrhage (without statement as to its cause) was included with heart disease in these years, but the deaths from this cause would probably affect the rates only to a very small extent.

As regards cancer, many deaths have been included under this heading in recent years, as the result of enquiries addressed to certifying practitioners concerning deaths stated indefinitely

* *I.e.* only those deaths certified as "General Paralysis"; not those from "Insanity," "Melancholia," etc.

to be due to "Tumour," "Growth," etc. Remarks as to this procedure will be found in most of the recent Reports.

The mortality from diseases of the blood-vessels showed an excess during 1881–90. Table 20 of the Annual Report for 1904 (and the corresponding table of earlier reports) shows that the death-rate at "all ages" from "Apoplexy" and "Hemiplegia" was high during these years; this probably accounts for the excess, because they are mainly diseases of advanced life.

DEATHS FROM Malignant Disease in England and Wales in the Six Years 1901–1906.

Part of the body affected.	Males.					Females.				
	All ages.	55—	65—	75—	85 and upwards.	All ages.	55—	65—	75—	85 and upwards.
Skin (face, lip, nose, scalp, ear) ...	2,873	584	829	756	196	1,317	206	378	395	113
Stomach	15,553	4,984	4,679	1,566	89	14,737	4,410	4,508	1,805	166
Intestines	5,439	1,593	1,648	657	44	7,380	2,115	2,273	1,013	111
Rectum	7,277	2,258	2,186	876	79	6,185	1,745	1,718	786	85
Uterus	—	—	—	—	—	23,590	6,219	3,828	1,277	150
Breast	133	34	45	16	3	17,305	4,497	3,621	1,982	409
Œsophagus	4,505	1,662	1,163	362	24	1,537	367	412	190	17
Liver and gall-bladder	9,328	2,992	2,786	1,052	106	14,112	4,414	4,312	1,740	171
Pancreas	1,252	388	310	90	4	1,178	390	324	109	11
Bladder and urethra	3,240	617	792	322	39	949	248	308	162	21
Pharynx, throat	1,557	541	377	114	6	453	121	87	48	2
Larynx, trachea	1,348	479	330	93	5	458	116	88	20	5
Thyroid	120	41	27	9	—	335	101	87	33	6
Tongue	3,898	1,353	899	319	24	521	120	141	75	7
Mouth	1,327	420	392	134	17	255	61	74	29	5
Prostate	744	208	317	139	10	—	—	—	—	—
Peritoneum	645	181	145	59	5	1,642	504	434	161	16
Pleura	51	14	9	6	—	57	17	11	3	—
Ovary	—	—	—	—	—	2,012	501	274	66	4
Kidney and suprarenals	759	186	144	50	2	803	192	153	62	6
Testes and penis	1,064	199	202	124	21	—	—	—	—	—
Lung	908	245	158	31	4	723	177	127	29	2
Lymphatic glands of neck... ...	2,078	653	453	196	17	657	151	144	95	12
Abdomen (organ not stated) ...	943	258	259	95	6	1,876	499	560	233	27
Other stated organs or parts ...	6,810	1,684	1,394	626	72	5,265	1,178	1,105	581	122
Part not stated	749	217	166	71	11	1,071	236	246	103	18
Total	71,601	21,791	19,710	7,763	784	104,418	28,615	25,216	10,997	1,486

Reference.—Abridged from pp. c–ciii of Registrar-General's 69th Annual Report.

Proportions of Males aged 45–55, 55–65 and 65 Years and upwards to 1,000 Males (aged 15 and upwards) engaged in each occupation, 1901 Census.

Occupation.	45–55.	55–65.	65 and upwards.
Performer, showman	111	49	19
Railway porter, servant...	105	54	16
Carman carrier	116	55	18
Bargeman, lighterman	164	102	43
Dock, wharf labourer	186	92	27
Coalheaver	165	79	27
Stone quarrier	158	88	35
Anchor, chain maker	151	94	41
Ship plater, riveter	111	48	8
Builder's labourer	173	83	26
Bricklayer's labourer	133	60	21
Mason's labourer	149	87	29
Plasterer's labourer	118	49	14
Navvy, railway contractor's labourer	174	88	26
Pavior, road labourer	193	182	148
Railway platelayer	180	109	36
,, labourer	134	82	36
Seaman, merchant service	150	82	28
Agricultural labourer	132	111	92
Coal and shale mine-hewers	132	55	12
,, ,, below ground ...	94	58	19
,, ,, above ,, ...	139	95	41
Slate quarrier	162	99	42
Clay, sand labourer	138	81	31
Brick, tile maker	117	69	31
All occupied males	136	82	41
All males...	133	87	63

Most of these occupations show a considerably lower proportion at ages 65 and upwards than exists among occupied males generally. The large proportion at this age among road labourers is probably due to the practice, especially in country places, of employing old men for some processes of work on the roads, *e.g.*, stone breaking.

I have compared these figures, so far as changes of classification will allow, with the proportions which prevailed in 1891, when the proportions were similar.

Reference.—Compiled from 1901 Census, Summary Tables, Table XXXV.

(*To face p.* 32.)

MEAN ANNUAL DEATH-RATES in certain Occupations in the Three Years, 1900, 1901, 1902.

	Number living at each age per 1,000 at ages 15 and upwards.			Mean Annual Death-rates per 1,000 living from— All causes.			Cancer.			Diseases of nervous system.			Diseases of circulatory system.			Diseases of respiratory system.		
	45–55.	55–65.	65 and upwards.	45–55.	55–65.	65 and upwards.	45–55.	55–65.	65 and upwards.	45–55.	55–65.	65 and upwards.	45–55.	55–65.	65 and upwards.	45–55.	55–65.	65 and upwards.
Railway guard, porter, etc. ...	129	59	15	13·99	28·83	79·13	1·28	3·14	8·25	1·05	3·83	11·89	2·44	5·51	15·07	2·31	5·42	14·43
Carman, carrier	116	55	18	20·42	36·46	107·84	1·46	3·83	6·88	1·55	3·65	14·87	2·92	6·78	19·29	4·44	9·44	25·54
Bargeman, lighterman, waterman	164	102	43	24·11	38·95	115·52	1·80	4·12	7·67	1·59	4·23	11·63	3·95	7·46	21·15	5·33	8·13	27·23
Dock labourer, wharf labourer ...	186	92	27	26·89	38·39	69·34	1·72	2·99	4·73	1·66	3·73	9·75	3·81	6·51	11·00	7·21	12·29	20·05
Boiler maker	141	72	18	18·82	37·86	88·20	1·88	4·72	5·56	1·57	5·64	15·49	3·08	6·36	17·88	4·55	9·75	20·66
Nail, anchor, chain manufacturer	140	74	24	22·43	40·15	124·70	1·46	3·52	8·94	1·84	4·41	17·63	3·30	7·49	19·04	6·48	11·44	30·09
Shipwright, etc.	149	100	34	13·74	28·03	77·58	1·16	2·74	5·84	1·45	3·68	11·92	2·47	5·69	12·49	2·61	6·82	16·27
Coal miner	123	59	16	14·67	35·98	139·82	1·03	2·79	6·70	1·09	4·33	19·30	2·36	6·91	23·70	3·29	10·16	39·03
Ironstone miner	171	96	30	12·23	27·97	98·27	0·70	3·31	7·30	0·58	2·69	11·29	1·28	4·76	17 93	3·61	4·97	15·27
Stone, slate quarrier	159	91	36	18·13	34·42	94·23	1·04	3·07	7·29	0·98	3·18	11 71	2·49	6·09	20·70	4·24	8·33	20·56
Coalheaver	165	79	27	21·54	33·06	79·55	1·33	2·44	5·21	1·49	2·93	8·52	3·45	7·33	12·31	5·25	8·47	26·04
Railway platelayer and labourer, road labourer, etc.	174	121	67	13·23	24·85	62·77	0·91	2·66	4·69	1·13	2·14	7·67	2·14	4·87	11·21	2·76	6·38	14·39
Seaman—merchant service ...	150	82	28	28·33	41·71	135·79	2·38	4·93	13·41	2·36	4·93	21·28	4·58	8·82	26·08	4·00	6·60	22·14
Farm labourer, servant	132	111	92	10·63	19·33	84·38	1·08	2·30	5·49	0·81	1·99	10·11	1·94	4·31	16·37	1·76	3·38	15·37
Brick, tile maker	117	69	31	12·36	21·52	83·94	1·53	2·18	5·77	1·19	2·76	11·54	1·68	4·44	17·12	2·47	5·02	20·84
All males	133	87	63	18·67	34·80	94·61	1·45	3·62	6·38	1·95	4·63	13·51	2·76	6·74	16·45	3·38	7·18	18·30
All occupied males	136	82	41	17·73	31·01	88 39	1·42	3·31	6·68	1·53	3·67	12·03	2·66	6·09	16·40	3·32	6·54	17·77

Reference.—Compiled from the Tables in the Supplement to the Registrar-General's 65th Annual Report (Part II): the first three columns from Table VI (pp. cxcii–cc), the next three columns from Table II (pp. cxxxiv–cxli). The other rates are specially calculated from the Tables on pp. 2–159.

Note.—The figures for railway porters cannot be separated from those for railway guards.
" boiler riveters " " other boiler makers.
" anchor, chain makers " " nail makers and other iron and steel manufacturers.
" ship riveters " " other ship builders.
" stone quarriers " " slate quarriers.
" railway platelayers " " railway labourers and road, etc., labourers.

"All males" include the insane: this accounts partly for the higher death-rates from diseases of the nervous system among them than among "occupied males."

Comparative Mortality Figures, 1900, 1901, and 1902.

(Ages 25–65 Years.)

Occupation.	All causes.	Cancer.	Diseases of nervous system.	Diseases of circulatory system.	Diseases of respiratory system.
Railway guard, porter, &c.	773	59	64	113	123
Carman, carrier	1,094	71	81	151	241
Bargeman, lighterman, waterman	1,235	75	87	180	222
Dock labourer, wharf labourer	1,374	67	86	176	341
Boiler maker	971	82	106	142	208
Nail, anchor, chain manufacturer	1,137	66	91	165	311
Shipwright, etc. (wood and iron)	765	53	70	132	155
Coal miner	846	51	72	130	189
Ironstone miner	723	52	42	90	139
Stone, slate quarrier ...	905	53	60	117	204
Coalheaver	1,144	57	70	174	259
Railway platelayer, labourer, road labourer, etc.	707	48	51	109	148
Seaman, merchant service...	1,547	103	116	233	203
Farm labourer, servant ...	572	45	48	95	88
Brick, tile maker	622	53	55	88	126
All males	1,000	68	105	144	174
All occupied males... ...	925	63	78	135	165

The figures are to be read thus :—

Among a certain number (71,005) of men aged 25–65 years in the general population 1,000 deaths would occur annually; of these 68 would be due to cancer, 105 to diseases of the nervous system, etc. Among the same number of "occupied males," with the same proportions living in each of the age-groups 25–35, 35–45, 45–55, and 55-65 years, 925 deaths would occur annually, of which 63 would be due to cancer, 78 to diseases of the nervous system, etc. Similarly for the several occupations.

Reference.—Supplement to the Registrar-General's 65th Annual Report, Part II, Table IV, pp. clviii–clxxxi.

DEATH-RATES from Childbirth (including Puerperal Septic Diseases).

	Death-rates per 1,000,000 females living.
1861–70	335
1871–80	343
1881–90	312
1891–1900	295

The rates for the decennia 1861–70, 1871–80, and 1881–90 have been calculated on the assumption that the proportion of females living in each age-group was the same in each of these decennia as in 1891-1900.

The high mortality in 1871–80 is due to the excessive number of deaths from childbirth during 1874 and 1875.

The deaths in the years 1871–7 were as follows:—

	From puerperal fever.	Other accidents of childbirth.
1871	1,464	2,471
1872	1,400	2,403
1873	1,740	2,375
1874	3,108	2,819
1875	2,504	2,560
1876	1,746	2,396
1877	1,444	1,999

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